
By Express Mail # EV36305488US

# APPLICATION FOR UNITED STATES LETTERS PATENT

## FOLDING DEVICE WITH A FOLDING DRUM

Inventor:
**Hubert SCHALK**

# FOLDING DEVICE WITH A FOLDING DRUM

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

[0001] The invention relates to a folding device with a folding drum for producing the second longitudinal fold in products which have been produced with a rotary press.

### 2. Description of the Related Art

[0002] The basic construction of a folding device which comprises a folding drum is disclosed in US Patent No. 2,919,914. The folding device of this reference includes a folding blade which is secured in the folding drum and is moved into the region between two folding rolls and out again on a cycloid path. During the process, the folding blade presses the product to be folded into a gap between two folding rolls. The folding blade is fastened to a folding-blade carrier arranged on a folding-blade shaft. Both ends of the folding-blade shaft are mounted in the folding drum so that the folding blade is mounted at two points.

[0003] High flexural loading of the folding-blade shaft results from a high rotational velocity of the folding drum such that the folding-blade shaft discernibly deflects in the central region and the folding quality thus becoming worse as the velocity increases.

## SUMMARY OF THE INVENTION

[0004] It is an object of the invention to provide a folding device which makes higher folding speeds possible without reducing the folding quality.

[0005] The object is achieved according to the invention using a folding device having a folding-blade shaft having two ends, wherein both ends are rotatably mounted in a folding drum. The folding-blade shaft has at least two folding-blade carriers for holding folding blades. The folding-blade shaft is mounted in the folding drum at both ends by bearings and between the ends by at least one further bearing, wherein the at least one further bearing is preferably being arranged between the folding-blade carriers.

[0006] One substantial advantage of the folding device is that the folding-blade shaft is configured with at least one further bearing point in the region between the bearing points at the two ends. At least two folding-blade carriers are arranged on the folding-blade shaft, wherein the at least on further bearing point which is arranged between the bearings at the two ends is preferably arranged between the folding-blade carriers.

[0007] Another advantage of a folding-blade shaft of this type, which is configured with at least three bearing points, is that it is possible to counteract a deflection of the folding-blade shaft in the central region. Production is possible at an increased rotational speed over the prior art as a result of the reduction of the deflection of the folding-blade shaft and of the folding blades arranged on the said folding-blade shaft by the folding-blade carriers. The bearing points are preferably configured with

self-aligning roller bearings. The bearings can be supplied with lubricating medium, preferably grease, by a central lubricating-medium supply means.

[0008] It is possible to reduce the weight of the entire folding device, preferably the folding drum and/or the folding-blade shaft with the folding-blade carrier, as a result of the at least one further bearing point arranged between the bearings at the two ends, as the forces resulting from the rotation are distributed over at least three bearing points. The distribution of forces over at least three bearing points allows the folding drum to be designed with a smaller wall thickness to accommodate the bearings serving to mount the folding-blade shaft at the two ends, such that the overall mass of the folding drum is reduced. High overall rigidity of the folding-blade shaft with blade holding means and a reduction in the overall mass of the folding-blade shaft, folding-blade carrier and folding blade with a simultaneous reduction in the manufacturing costs can also be achieved by mounting the folding-blade shaft using the at least three bearing points. It is possible to increase the service life of the bearings at an identical rotational speed and to increase the rotational speed with identical loading of the bearings as a result of the reduction in the overall mass of the folding-blade carrier including the folding-blade shaft and folding drum. The lower weight of the folding-blade carrier, in particular, increases the service life of the bearings. The mass of the folding drum is also reduced again overall, as a smaller rotating mass has to be balanced. This in turn reduces the required drive power and, in some circumstances, the manufacturing costs.

[0009] The rotational motion of the folding-blade shaft is advantageously introduced via a spur gear which serves as a drive pinion and is arranged on the folding-blade shaft by form-fitting serrated toothing. This form-fitting connection between the folding-blade shaft and spur gear increases the reliability of the introduction of motion.

[0010] Furthermore, the consequences of the additional bearing in the central region of the folding-blade shaft which accommodates the folding-blade carrier are a smaller deflection of the folding-blade carrier, less oblique positioning of the drive pinion and the possibility of reducing the tooth play. The folding accuracy is increased as a result of the smaller tooth play.

[0011] It is significant that the carrier for accommodating the at least one additional bearing in the central region of the folding-blade shaft is firstly configured with a small material thickness in the longitudinal direction of the folding device and secondly, however, the carrier is configured with a large area which extends over approximately the entire cross section of the interior of the folding drum in the transverse direction of the folding device, in such a way that the stability and torsional rigidity are ensured despite the small material thickness.

[0012] One advantage of the small material thickness of the at least one carrier is that it is possible to arrange the folding blades very close to one another in the region of the carrier, the gap between the folding blades preferably being smaller than 10 millimeters.

[0013] Other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims. It should be further understood that the drawings are not necessarily drawn to scale and that, unless otherwise indicated, they are merely intended to conceptually illustrate the structures and procedures described herein.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0014] In the drawings, wherein like reference characters denote similar elements throughout the several views:

Fig. 1 is a sectional view along a longitudinal axis of a folding device with a folding drum; and

Fig. 2 is a sectional side view of the folding device according to Fig. 1.

## DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

[0015] Fig. 1 shows a folding device with a folding drum 1. The folding device may be used to produce a second longitudinal fold in products which have been produced with a rotary press. It is also possible, however, to fold sheets.

[0016] The folding drum 1 comprises two folding blades 2, 16 which are each clamped in a folding-blade carrier 3, 17 (see Fig. 2). The folding blade 2, 16 comprises a planar, thin metal sheet and has a thickness of less than 1 mm such as, for example, a thickness of 0.5 mm. It is made from a fine metal sheet (strip steel) delivered as a semi-finished product without its upper and lower side having been processed. The contour of the folding blade 2, 16 can be produced simply using laser cutting and its front edge is advantageously slightly bevelled.

[0017] The folding blade 2, 16 is clamped between a surface of the folding-blade carrier 3, 17 and the surface of a clamping strip 4, 18, the clamping strip 4, 18 being screwed to the folding-blade carrier 3, 17. The folding-blade carrier 3, 17 is arranged on a folding-blade shaft 5 and the folding-blade shaft 5 is rotatably mounted in the folding drum 1.

[0018] The folding-blade carrier 3 is advantageously connected to the folding-blade shaft 5 by a pin connection 6 (see Fig. 2). The folding blade carrier 17 is similarly connected using a separate pin connection similarly to the connection of folding-blade carrier 3 shown in Fig. 2. The folding blades 2, 16 are produced in one operation before being installed in the folding drum 1. In this production process, the unprocessed folding blades 2, 16 are fastened in the respective folding-blade carrier 3, 17, the

folding-blade carriers 3, 17 being arranged on the folding-blade shaft 5, preferably clamped, and being secured in their position relative to one another using the pin connection 6. The said pin connection 6 serves to locate the exact position of the finally processed folding blade 2, 16 or the folding blades 2, 16 with respect to one another during installation in the folding drum 1.

[0019] At its ends or at least in the region of its ends, the folding-blade shaft 5 is mounted in side walls 7, 8 of the folding drum 1 by bearings 9, 10. The folding-blade shaft 5 is additionally mounted between the two folding-blade carriers 3, in this case in the centre, by a further bearing 11 which is arranged in a carrier 12. The carrier 12 is connected to the folding drum 1 and is preferably screwed to the folding drum 1 (Fig. 2). The carrier 12 comprises a thin sheet-metal blank which has a relatively large area, the carrier 12 extending over virtually the entire cross section of the interior of the folding drum 1. The material thickness of the thin sheet-metal blank of the carrier 12 is preferably configured to at least correspond to the bearing-eye thickness of the bearing 11 which is attached there.

[0020] The bearings 9 to 11 are preferably configured as self-aligning roller bearings, it being possible to supply the latter (in a manner not shown in greater detail) with lubricating medium, preferably grease, by a central lubricating-medium supply means via supply channels, supply bores or supply lines which are arranged on or in the side walls 7, 8 and in the carrier 12.

[0021] At one end of the folding-blade shaft 5 there is arranged a drive pinion 13 which is secured to the folding-blade shaft 5 by a screw connection 14. The drive pinion

13 is connected to the folding-blade shaft 5 with a form-fitting connection by serrated toothing 15. A clamping element 20 provides the force-transmitting connection between the drive pinion 13 and folding-blade shaft 5.

[0022] The form-fitting connection between the folding-blade shaft 5 and the spur gear configured as a drive pinion 13 increases the reliability of the introduction of motion.

[0023] Thus, while there have shown and described and pointed out fundamental novel features of the invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated, and in their operation, may be made by those skilled in the art without departing from the spirit of the invention. For example, it is expressly intended that all combinations of those elements which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Moreover, it should be recognized that structures and/or elements shown and/or described in connection with any disclosed form or embodiment of the invention may be incorporated in any other disclosed or described or suggested form or embodiment as a general matter of design choice. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.